

# AVIATION

AND

## AIRCRAFT JOURNAL

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CLEVELAND

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# AVIATION AND AIRCRAFT JOURNAL

Vol. IX

DECEMBER 12, 1929

No. 12

### Secretary Daniels' Boomerang Argument

**T**HE annual report of the Secretary of the Navy has been made to the President and a great amount of information regarding naval aviation is contained in the recommendations. Secretary Daniels recommends that the Navy operate all government vessels.

It is significant to note that the arguments that are used for the naval operation of transports, harbor boats, buoys, lighters, the ships of the Shipping Board, Coast Guard, Public Health Service and all the other water craft of the various bureaus of the government are those to which the Navy has been opposed when used in favor of a united air force. To quote from the argument:

"It seems should have but one Navy. At present there are various 'little navies,' competing activities conducted under the supervision of different departments whose vessels could be far more advantageously operated under a single control. Economy and efficiency in government are the ends we are at seeking—the placing of governmental activities where they can be most effectively operated, preventing duplication of effort and material, eliminating lost motion, and securing the best possible service at minimum expenditures. One of the main principles in operation is that all the forces engaged in the same kind of work should be concentrated under one head and in one organization."

No better logic has ever been pressed for a united air force and it needs no further elaboration.

### Piloting in a Race

**D**URING the last year there have been several examples of the difference between a speed record over a straight course and a speed race. The difference is caused by the necessity of turning corners and sometimes by rushing landings and take-offs. In these requirements the pilot is the deciding factor and a very good machine may be defeated by a poorer machine with a better pilot.

During the recent Pulitzer Trophy contest all of the winners made excellent turns at the pylons while some of the others lost time at such turns. Each of the first six entries drew favorable comment from the pilots who saw the race from the ground. These pilots were in order, Mooney, Hartney, Lewis, Street, Lawrence, and Rodell. To these should be added Handley in the Loening special. Both Lawrence and Rodell were competing for close prizes in a field of standardized machines.

A large gain of controllability at the expense of two or three miles an hour of maximum speed sacrificed, would probably have a more favorable effect on the chances of the machine's winning a race than giving the machine a slightly increased speed at the expense of controllability. This is being recognized all over the world and foreign nations are prone to state that the Gordon Bennett race was won because the

French machines were better piloted. This is not so. The American pilots were as good as any they were pitted against. Manufacturers should consider carefully the conditions of a race in designing an entry and pilots should always bear in mind that the final decision depends largely on the way they fly the course.

### Col. Clark Leaves Army

**O**NE of the greatest losses that the Army Air Service has sustained since the peace time organization has been effected is the retirement of its chief aeronautical engineer Col. V. E. Clark to engage in civilian airplane construction. It brings to the attention of the public, again, the fact that in a highly specialized branch where men of a high order of engineering judgment are needed, that the equipments at present available are inadequate and unless substantial provision is made for such talent by legislation, the Army will always be at a disadvantage. The Navy has also an instance in the retirement of Commander Cushman who was in charge of the Naval Aircraft Factory and is now engaged in civilian work.

To lead the world in aeronautics as the United States will be if the plans now in formation are carried out, the best technical skill must be secured and to retain or attract such ability will be one of the most difficult problems that will come before the Air Service.

The many years that Colonel Clark has spent in specialization have given him an international reputation and placed him in the front front of his profession. The Air Service has lost the industry's man, but the privilege behind the change will, it should be noticed, benefit the service and under McCook Field, the Air Service engineering center, bureau of the high grade talent that it should have at its disposal.

### Unguarded Story

**T**HE New York World printed the following headline on aviation during the Pulitzer Trophy Race:

"High officers of the Navy no longer make a secret of the fact that this country is planning a trans-Pacific flight. Two or three who were at Mitchell Field Thursday discussed the machine with which it will be undertaken, a one-seater plane of 3,000 horsepower or more."

"The trans-Pacific plane is already taking shape at the navy establishment at Philadelphia, but it will be another year before it will be ready to try."

This is one of the subjects that is usually guarded with the utmost secrecy and it is interesting to know that it is a matter that newspaper men feel that they can write about with such certainty. Secretary Daniels in his report refers to this airplane but does not mention the purpose for which it is to be used.







## New Wright Aeronautical Engine

The recent announcement of the Wright Aeronautical Corp. that it had so changed and improved the engine which it has long manufactured as the Wright Hispano that it had changed all the same to Wright, is of deep interest in the aeronautical world.

First the engineers of the Wright-Martin Co., parent organization of the present Wright company, brought back from France with them the plans of the Hispano-Buiss and the right to make factory in America. Then, change after another was made in the engine design until the whole lot has been so reconstructed that the American builders with this present and approval of the Army Air Service placed their own name upon the product and it was known as Wright-Hispano. Further improvements have so changed the engine that it is actively American now, and in the words of E. B. Restek, vice-president of the company, "no more a Hispano-Buiss engine than the Liberty is a Gnome-Moreno."

"Nothing in this world can remain stationary," Mr. Restek says, "it either goes forward or backward. This is especially true in everything pertaining to aeroplanes. An outmoded engine and old design constantly need to be improved to meet the changing demands placed upon it by the plane designers and by the needs of the Army and Navy Air Service. Our engineers have so improved the Hispano-Buiss that we consider we are participating in changing the name to that of the 'Liberty of Being,' the Wright brothers."

The great success of Allied war is "Blame" no more, but much has against the fact that Germany would produce an engine line is well known. The Span was long expected to be a one-sided on the western front. But several years have passed since that time, and a year measured in terms of aeronautical improvement is a long time. The Wright Aeronautical Corp. placed the Hispano as the best engine in the world when its experts had studied various types for more than a year.

Their engineers, however, were not satisfied merely to turn up Hispano even after the American rights, had been purchased and the Air Service changed for huge production. The first 2,500 made at the big New Dearborn plant were only slightly modified, but then modification was so successful that a number of changes in design were made with the consent of the Air Service.

The Hispano as it came to America was delicate, sensitive and high speed. The big defect lay in the cylinder base durability. It was therefore toward greater ruggedness and reliability that the Wright engineers worked, although they preserved the lightness and great flexibility of the original motor.

"By means of the change the Wright Corp. made in cylinder construction over the original Hispano, this engine is capable of no longer that of any other aeromarine motor," Mr. Restek continued. "The Corporation was well aware of the criticism against the Hispano to the effect that the valves were delicate and not short the solution of this problem. To eliminate the trouble obtained by the change in cylinder construction, the Wright engine has been running at McCook Field, Dayton, in ordinary flight for more than 100 hours without overhaul, and at the last report was still running, causing no trouble. The valves on the engine have never been ground nor has any other repair work been done."

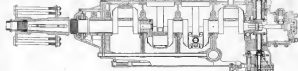
More than 10,000 major mechanical changes and improvements have been made in the "Hispano" by the Wright engineers.

The early French engine had very thin heads in the cylinder and considerable trouble was experienced with the valves. At first the Wright engineers thought the trouble was due to valve material, but careful study revealed that it was due to cylinder warpage. The better cooling obtained from the thick head is analogous in the great results resulting from the use of a thick piston head. Valves, especially exhaust valves, are the hottest parts in any engine.

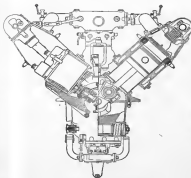
and the only way heat can escape from them is through the seat. Naturally the rate of heat out of the valve seat and the level will increase as the temperature difference between the two parts increases, and the speed of valve seating, other things being equal, will vary with the total area of the contact between the seat and its seating.

In the original Hispano there was quite a narrow section of the steel head at the point of nearest approach of the two valve heads. It was obvious from examination of old engines that this part of the head could get hot enough to distort, and when it distorted it warped the valve seat, causing leakage and interfering with the seating of the valves.

Adding mass, to the thickness of the



LONGITUDINAL SECTION OF THE WRIGHT ENGINE



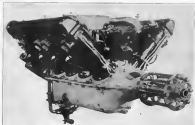
TRANSVERSE SECTION OF THE WRIGHT ENGINE

valve seats head has increased the cross sectional area of the middle part to a great extent it can conduct away the heat more, is even under the most severe conditions without warping at a greater rate than the remainder of the head. Consequently the valve seats stay true and the valves seat properly.

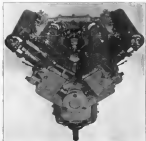
The valves themselves were also somewhat changed in design. The size of the neck was increased to allow a better flow of air away from the face of the valve, thus keeping it cooler and making it less likely to burn. The design of the cylinder block was changed to allow increased ventilation of cooling water around the exhaust valve seats.

The installation of American magnetos and an American ignition system was one of the first changes made, but in the new model the magneto mounting has been also improved. As well be seen in the illustration the two magnetos are attached with their breaker rods raised up so that the same openings in the casings which give access to the spark plugs also let have the distribution.

Then again, in the other design the magnetos were driven by a single intermediate shaft with a coupling on either end, which meant that one magneto ran right hand and the other left, and therefore necessitated a double neck of sparkers. In the new layout the magnetos are driven by two, separate level pinions making with one master level, and thus they rotate in the same direction.



FRONT END OF WRIGHT ENGINE SHOWING OIL SUMP AND MAIN DRIVE SHAFT



REAR END OF WRIGHT ENGINE SHOWING NEW INCLUSION MAIN DRIVE SHAFT

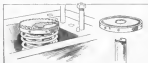


NEW TYPE OF ADJUSTMENT OF WATER PUMP DRIVE  
DESCRIBED HERE

Yet another advantage of tilting the magnetos is that it places the water side of the bracket, which permits the belt hangers to be run right back along the fuselage, thereby the place draught work to do this.

The design of the piston was altered completely. The piston pin was changed from the fixed to a floating type. The modified fixed piston does not run so easily and is a better accommodation for the crank pin. This permitted the piston pin to rub against the cylinder wall, wearing it and spreading the water seal to excessive wear and tear. The floating type of piston pin, it has been found, gives better wear than the fixed type.

The first type of floating pin used was held against wear by aluminum rings bolted into the piston ring grooves, as in the Liberty engine piston, but this has been supplanted for the new engine. Here a mild, rounded brass bar is forced into each end of the hollow pin, fully protecting the walls of the cylinders against scratching.



ON THE WATER PUMP DRIVE, THE TIGHT ADJUSTMENT IS  
OBTAINED BY THE SPRING VALVE SPRING WEIGHTS

Another change is the provision of four separate ring grooves instead of placing a pair of rings in each of two grooves. This keeps the rings cooler, decreases the wear on the sides of the grooves and makes a tighter job altogether.

Changes were also made in the connecting rod and bearing. The French make something of a rod and bearing were identical with each other. This made the lightest possible construction, but defects were that the manufacturers could not make them sufficiently difficult and their life in actual service very short even under the best of conditions. The change to the Wright type gives a great increase in durability of this member, and also makes a simpler manufacturing operation.

A new member for the float was also developed. The new member has many merits, but the most important is the more complete control of the mixture. This is especially useful at altitude work.

The French design of the lower half of the crankcase was for a wet sump design, that is, an carrying its own oil in the lower portion of the crankcase. On several occasions when the lower half was tested there was danger that the oil would be frock or in the rear would be frocked. The first American modification was to use an auxiliary oil pump placed on the rear of the motor bracket to make the motor a dry sump job. This was found to be only a makeshift. A later design placed all oil pump together in a compact unit, easily accessible and properly placed.

From the technical drawings it will be seen that there is a main pressure line across the crankcase, due a certain loss from the front and throat.

The pump assembly comprises three separate pumps, one the pressure pump, one the suction pump drawing from the front end of the case and the third feeding from the rear end. Either of the suction pumps alone can discharge oil from the crankcase faster than the pressure pump can take it from the tank, therefore the crankcase is certain to be dry, dry. A neat detail is that the lower pump operates through a valve which the crankcase is made automatically when the pump is put in place. Quite a small opening in the lower pump beneath the engine allows it to permit the easy removal of the oil from the crankcase.

On the other hand, the front end of the crankcase housing is run back down to the crankcase to take care of oil which is in the pump when it is doing, as well as to prevent the crankcase from free circulation and possible leakage from the valve stem.

A slight change was also made in the upper half of the crankcase in order to give oil a direct lead to the front thrust bearing. This improvement permits undisturbed lubrication of the bearing, which is very heavily loaded and is also a pre-arrangement against possible trouble from partial failure of splash lubrication. The rear end of the crankcase was slightly changed to accommodate the magnetic bracket, which is interchangeable on the 160 and 200 horsepower engines.

One change which will be very much appreciated in maintenance shops is the addition of a device which makes timing easy in the Hispano engine fitting was a somewhat complicated process, involving changing the mesh of several pairs of bevel gears and the making of the crankshaft gear as in the Liberty engine. The bevel gears at the upper end of the vertical crankshaft drive shaft is so large compared with the shaft itself, but is held in it by a serrated jaw coupling with very fine teeth. By shaking off the nut at the extreme top of the vertical shaft the coupling is broken and the case



ON THE WATER PUMP DRIVE, THE TIGHT ADJUSTMENT IS  
OBTAINED BY THE SPRING VALVE SPRING WEIGHTS

shaft can be turned freely. The teeth of the coupling are the enough to enable an adjustment of as little as one and a half degrees to be made without an inch movement of the shaft which is even less than was possible by the laborious process used in the old engine.

The design of the water-pump attachment and oiler is directly related to make them more compact and accessible. A two-pump for handling gasoline without the use of a pressure tank and air-pump has been provided on the bottom of the

new magnetos bracket, and provision has been made for the installation on the magnetos end of the engine of a standard type electric starter.

Not unlike the "Ansonian" engine is, in the opinion of many aeronautical experts besides those of the Wright Corp., an new period as it is possible in this year, 1929, the work of it is in improving and increasing in price about as steadily as the Wright engine as on the old "Bliss" from which it developed.

## Selection of Air Routes and Flying Fields

By C. Le Roy Mailing

Patton, Fort, Washington, D. C.

There is, it seems, a vagueness in the opinions of many people regarding the value of meteorology in the selection of air routes. One reads of "best" and of "worst" flights by which it is implied that a single bearing on, or most recent, journey over a proposed course will afford sufficient data to designate that route as satisfactory or unsatisfactory for continued use. Such reasoning is unwise. It is obvious that the aerial route is composed of such a host of variable elements that the route which one flight only can select as most agreeable is probably the same combination for months or even years.

Of what profit, then, is it to measure the temperature, humidity, and other elements, and to select a route on the basis of these data to be used in the discussion of the flight itself, relative to the performance of the motor or mechanical equipment, the psychological reaction of the travelers, or as an aid to the selection of the route? It is not the form of speed itself? If such observations are to be made, they should be made over a wide area, by numerous craft, and so nearly simultaneously as possible.

The sense of air is far from being a fixed thing. Perhaps, the lifting of the atmosphere to the upper ocean is a form of speech which has been somewhat corrected, and has been the popular conception of aerial currents as found in the Gulf Stream and the Azores Current. It is not the power work of Hatz and Palmer, "Chances of the Airplane for Armaments and Aviation," which appeared in 1913, did not lay sufficient emphasis upon the pitfalls of the good winds in general.

Our atmosphere is not made up of great permanent streams and currents, and even our conception of prevailing westerly winds is sometimes checked by the spectacle of distant storms, blowing from the east or north. Therefore, it seems to lay down definite averages without reference to the fundamental conditions which really determine desirable routes even on present theory. It would be better to select that air route which is most favorable in a position of slight advantage. It would be better to select that air route which is most favorable in a position of slight advantage. It would be better to select that air route which is most favorable in a position of slight advantage.

### The Selection of Routes

It is not sufficient that the point of departure and the destination must determine the general direction of flight. For it is by no means uncommon that the air shall flow in a straight line between two points, and yet the route, as determined by physical characteristics, and the weather along the route, may, in the last analysis, determine the course of the flight. It is not the distance with the greatest economy of time and fuel. In brief, it is the geography of the winds of the region between two stations which most determine the approximate route, but the weather at the time of flight most determine the details of the traveler's choice.

While the fact is recognized that a single condition may

not be representative of the weather over a given route, and also that even when taken over the same route may differ greatly from the conditions of any particular day, it is believed, nevertheless, that the best basis for laying out a preliminary route between two points lies in the mass values of certain climatological and meteorological factors.

Wind.—Perhaps the most important of all the weather elements to the aviator is the wind. It is necessary to consider, even to take advantage of any conditions which will aid in the selection of a route, and so it is of the greatest safety. If, then, the "best" route is to lay out in his mind, his first concern must be to determine the speed and direction of the prevailing winds over the proposed route. These winds should be determined, not at the surface alone, but to as great altitudes as the aviator can possibly. Moreover, it is very likely that he will discover that certain directions will, in the long run, be more favorable for flying in one direction, and that other levels will be more favorable for the return journey.

Route and then there have shown how important such wind studies are in regard to flying in southern Africa. The journey from Oau to Tana, they find should be made in an altitude of about 2,000 meters, because at this elevation a strong westerly wind prevails. The return journey is the "long" and it is not so favorable, as it is at altitude less than 1,000 meters, because the westerly wind at that elevation is greatly weakened in force. Such prevailing winds should be determined from as long records as are available and should be determined for the purpose of determining the route, and it is valuable, but monthly means would undoubtedly be better than less valuable in this connection are the means of thermal wind changes, both in speed and direction. In fact, such additional value being the conditions occur to those which the aviator is likely to encounter in flight.

Direction from the great main path between two points would be most helpful in cases of high winds and relatively low altitudes. Flying a high-powered airplane, flying at 110 miles per hour in a given wind would give a 10% advantage by departing from the great circle. But a dirigible, on the other hand, moving at 50 miles per hour would find it very difficult to make the same advantage. It is not the direction of the wind of the speeds were quite high and of the curvature of the wind path were such as eventually to bring it near its destination. Then, the gain to be made by departing from the great circle becomes smaller and smaller as the ratio of such speed to wind speed becomes greater.

Clouds and fog.—The influence of the lower clouds and fog upon flying is very great. As a rule, it is essential to know the location of these clouds and fog. When there are low clouds and fog, however, to keep in sight of the earth is obviously a hazardous proposition. The disadvantages of low flying when there is a cloud layer come down to the ground have been set forth by the author in "The Flying Book" by H. M. Mailing.

1. Route to the point, over to constant temperature, poor visibility, and proximity to the earth.
2. Danger of collision, occasioned by poor horizontal visibility.



# The Glenn L. Martin Commercial Transport

Altogether, if they are to be successful commercially, our no longer be dependent solely on the basis of performance as was done during the war. New standards have arisen. The efficiency, construction, appearance, the adaptability to the commercial adaptability. Like the biplane, the airplane and the crew, the commercial features of the airplane are paramount.

With this all-important factor of commercial airplane construction, the Glenn L. Martin Company of Cleveland is designing a new commercial transport which will incorporate every element of commercial adaptability. Among the principal points that are being carefully considered are the factor of safety, life of the plane, economy in operation, repair and replacement of parts, minimum work in airplane, simplicity in housing and landing.

## Fuselage

The fuselage is of general rectangular cross section, the maximum depth being 59 in. and the maximum width 50 in. outside. The fuselage is built on four spars and web longbones, running from a solid section in an "X" section, in going from nose to tail. The top longbone is horizontal in design and parallel to the axis of the engine. The lower longbone tapers upward toward the upper longbone as they approach the nose and tail.

The forward section of the longbone is of ash splined to the spars. The longbone is solid in front bearing points, the nose is formed with 3/32 in., 1-ply birch plywood walls and built up plywood bulkheads to the rear of the aft engine compartments are lined with plywood, and are lined and reinforced to carry stresses from the engine and also are provided in the central compartment for carrying heavy concentrated loads. From this point aft, the fuselage struts are spaced and are riveted out to the skin. These spars are stepped in wing fittings, which in turn, are braced to the fuselage fittings. The longbone fittings are of step form, made from sheet steel, entirely encircling the longbone. Each fitting, with a compound semicircular arc, brass wire.

The fuselage floor is of 1/8 in., 1-ply birch plywood, suitably braced and secured. Where spars longbone struts are used, they are, from the pilot's cockpit back, the bracing is of solid steel in rods. Fitted metal covering is provided around the entire cockpit and around and plywood doors are provided for the cargo compartments.

The tail end is mounted on a petrol post and secured for shock absorption with 1/2 in. elastic cord and 1/2 in. rebound rubber. The sled is of bakelite, provided with a cast steel shoe.

All walls of the fuselage, not built with plywood, are covered with grade "A" linen, doped and finished in black enamel. The exterior plywood walls are also finished with black enamel, the interior wood parts are also finished with black enamel, the interior wood parts are covered with blue lacquer or buff, the exterior metal parts are zinc plated and enameled in black, covering surfaces, etc., are ground.

## Wings

The wings are constructed in conventional type form in the center section with front and rear spars and intermediate struts and streamlines wing housing. The upper wing is made in two outer and one center section and the lower in two left and two right panels, a total of seven panels.

The intermediate struts, outside of the folding wing hinge, are of riveted spars, two front and two rear on each side of the wings. Tubular steel struts, fitted with clevises are used in the folding wing hinge. The strut spars around the wings, on the lower main panels, consist of a brass wall of steel tubes, faced with aluminum which connects the spar to the fuselage in the landing. The main struts are of stainless steel, fitted with turnbuckles of steel form.

Wing panels are built on two spars, spaced where necessary possible to 6 inches between, the front spar is 34 in. from the leading edge and the rear spar, 60 in. In the lower wing

section, an auxiliary triangle of steel tubes, inside the wing, carries the stress in the lower rear spar from the cross section to the front beam at the body hinge and to the lower spar at the rear of the wing compartment in the fuselage. The ribs are of brass type, with diagonal and vertical bracing, and are built of spruce; spruce drift screws are used to carry the drag loads and spruce bar ribs to close the ends of the panels.

The four ailerons are attached to the rear spar, upper and lower, at both sides of the section. The ailerons are reinforced and do not extend beyond the radius of the wings. The aileron is made of plate form, made of sheet steel with attached plate braced and secured to the beam by through bolts with bearing blocks of metal. Fittings take interplay about bolts, flying, landing, takeoffs and inverted drag, bracing wires. The aileron wing wires are of solid steel fitted with adjustable turnbuckles. The wings are covered with grade "A" linen and doped with 4 coats of sealer and two coats of elastic dope, in the order named, the latter being incorporated with khaki wing enamel. The wood frames of the wings are wood fitted and varnished.

## Landing Chassis

The landing chassis is attached under the fuselage and engine nacelle and consists of two 48 in. x 34 in. wheels and two riveted steel tubular axles. The axles are held in place laterally by the medium of wing braces attached under the fuselage and support the nacelle by means of a strut. The main strut is a heavy steel tube, made of sheet steel with attached plate braced and secured to the beam by through bolts with bearing blocks of metal. Fittings take interplay about bolts, flying, landing, takeoffs and inverted drag, bracing wires. The aileron wing wires are of solid steel fitted with adjustable turnbuckles. The wings are covered with grade "A" linen and doped with 4 coats of sealer and two coats of elastic dope, in the order named, the latter being incorporated with khaki wing enamel. The wood frames of the wings are wood fitted and varnished.

The landing gear A-struts are of solid steel tubing and are braced from the rear. Each wheel is shock absorbed with 1/2 in. elastic cord and the shock absorber is attached to the axle and the fuselage. The axles are provided for each wheel. The landing gear A-struts are constructed with wood and covered, where necessary, with grade "A" linen, doped and finished in black enamel. The wing braces are constructed with aluminum and magnesium. The wing braces are provided with steps to facilitate work upon the engine when they are not running.

## Tail Section

The tail surface consist of elevator, stabilizer, two rudders and two vertical fins, all built upon the stabilizer. The elevator is hinged to the trailing edge of the stabilizer and the rudders and fins are mounted on top of it. The entire unit is mounted on top of the fuselage tail and braced with steel tubing and steel bar rods or cables.

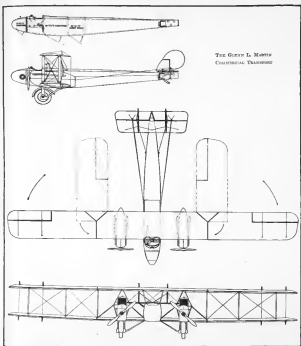
The tail surface and may be detached later. The stabilizer is adjustable from 0 deg. to minus 4 deg. from the pilot's cockpit, during flight. All tail surface frames are of steel tubing and are made in one section. The frames are doped and covered with grade "A" linen. The covering is doped and finished with khaki wing enamel.

## Power Plant

Each engine is mounted in the forward portion of its nacelle. The engine is built in the top, but is in a fixed plywood bulkhead, secured laterally by a horizontal plywood bulkhead, connecting it to the nacelle longbone. A slaying bulkhead connects the forward end of the engine nacelle to the front spar of the wing. The oil tanks are located beneath the engine.

The batteries are mounted inside the structure at the rear end of the engine. Directly behind the rear end of the starter is an aluminum casted plywood fire wall, which runs from the top to the bottom of the nacelle. On top of the fire wall and outside of the nacelle is the radiator.

Behind the fire wall and separated from it by an air space, is the gasoline tank. The gasoline tank side is the rear spar where there is another vertical bulkhead. Behind this bulkhead is a fitting to discharge the nacelle. A removable screw



THE GLENN L. MARTIN  
COMMERCIAL TRANSPORT

is provided for this, making it available for the storage of tools, etc. Detachable seating is also provided over the engine. All seating on the machine is sheet aluminum.

The engine controls are carried to the fuselage through the wings, being run over pulleys at the nacelle and at the inner end of the wings and being run through straight aluminum

tubes between these points. All controls are attached cable. A gravity tank is provided in the upper wing over each engine, and a night glass in the cowling line enables the pilot to determine at all times, whether gasoline is being pumped to the gravity tank. The entire gasoline system is designed to withstand a pressure of 5 lb. per sq. in.





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